CORRELATION BETWEEN FUNCTIONAL CLASSIFICATION AND KINEMATICAL VARIABLES IN ELITE WHEELCHAIR RUGBY PLAYERS

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INTRODUCTION: Wheelchair rugby is a Paralympic team sport for athletes with disabilities affecting the four limbs. Players are classified according to their functional level from 0.5 (lowest function) to 3.5 (highest function). A player's classification is based on muscle tests designed to evaluate the strength and range of motion of the upper limbs and trunk and also includes observation of the athlete on court (IWRF, 2008). Although the sport class is based on movement potential associated with neuromuscular function and performance of tasks related to the sport, it is not well known how functional classification in rugby correlates with variables strongly related to performance such as distance covered. In a previous investigation (Sarro et al., 2010), kinematical variables were analyzed in an international rugby competition and suggested a relation between functional classification and distance covered during the game. To further examine this relationship, this project aimed to investigate the correlation between functional classification and player physical performance as measured by distance covered during a game. In addition, the correlation was examined for each game quarter and as a function of velocity range.

METHOD: Video images of the 2008 Demolition Derby international wheelchair rugby tournament (Birmingham, AL) were obtained by two Basler cameras (4.0-12mm 1:1.2 1/2 CCTV) fixed at approximately 7.9 m above the court. The video images were captured, measured and visualized using a purpose-built interface. The positions of players who played an entire game (n = 18) during the tournament were determined simultaneously at 10 Hz. The players (36.9±5.7 years old) had spinal cord injury or were quad amputee. One player had classification 0.5, four 0.1, two 1.5, four 2.0, two 2.5, four 3.0 and one 3.5. The data were obtained with a tracking method based on computer vision techniques recently applied to characterize soccer player performance (Barros, et al., 2007). The distances between 44 points on the court were used to calibrate the cameras. The calibration parameters and the position of the players in the video sequences were used to reconstruct the 2D coordinates of each player using the Direct Linear Transformation method. Before analysis the 2D coordinates of the players' trajectories were filtered with a Butterworth low-pass zero-phase digital filter with a cut-off frequency of 0.4 Hz, determined by spectral analysis. For each player the following were computed: a) total distance covered during the game; b) distance covered during each quarter; c) distance covered in four different ranges of velocity (V1: $0 \leq V1 < 1.37$ m/s, V2: $1.37 \leq V2 < 2.74$ m/s, V3: $2.74 \leq V3 < 4.11$ m/s, V4: $4.11 \leq V4 < 5.5$ m/s). The distance covered was calculated as the cumulative sum of player displacement between two successive samplings. The association between the variables described above and the classification level of the players was determined by Pearson's correlation coefficients. A hypothesis test at $p < 0.05$ was applied to verify significance of each correlation.

RESULTS: Table 1 shows the correlation results and corresponding *p* values. A moderate significant correlation (r = 0.6) was found between functional player classification and total distance covered. Regarding player classification and distance covered in the four ranges of velocity, a significant correlation was found for the velocity ranges V3 (2.74 to 4.11 m/s) and V4 (4.11 to 5.5 m/s) during the total game and quarters 1, 2 and 4. No significant correlations were found in the velocity ranges V1 and V2.

Table 1. Pearson correlation coefficient *r* (*p*) between functional player classification and total distance covered (TD) during each quarter, during total game, and in each range of velocity [V1: 0≤V1<1.37 m/s, V2: 1.37≤V2<2.74 m/s, V3: 2.74≤V3<4.11 m/s, V4: 4.11≤V4<5.5 m/s].

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total Game
TD	0.57 (0.01)*	0.58 (0.01)*	0.58 (0.01)*	0.63 (0.00)*	0.62 (0.01)*
TD in V1	-0.33 (0.18)	-0.27 (0.28)	-0.19 (0.45)	-0.22 (0.38)	-0.31 (0.21)
TD in V2	0.05 (0.85)	0.05 (0.85)	-0.06 (0.82)	0.12 (0.62)	0.05 (0.85)
TD in V3	0.65 (0.00)*	0.79 (0.00)*	0.21 (0.40)	0.75 (0.00)*	0.70 (0.00)*
TD in V4	0.49 (0.04)*	0.58 (0.01)*	-0.09 (0.72)	0.56 (0.02)*	0.48 (0.04)*

* significant correlation ($p < 0.05$)

DISCUSSION: In general, moderate to strong correlations were found between the classification level of wheelchair rugby players and distance covered during a game, however this relationship was not detected at lower velocities. The distance covered during more demanding situations (i.e., when traveling at a velocity over 2.7 m/s) was strongly correlated to player functional classification, suggesting that the distance covered can be related to the functional ability for wheelchair propulsion. These results provide evidence for the use of distance covered during a game at different velocities as an auxiliary tool in the classification process of wheelchair rugby players. Support for the use of kinematical variables as part of player classification has previously been shown for other Paralympic sports, like shot-putting (height and angular speed of release) and basketball (shooting mechanics) (Chow et al., 2000; Malone et al., 2002). Adding quantitative evaluations to the traditional method of classification would lead to a more evidence-based system.

CONCLUSION: There is a strong correlation between the functional classification of wheelchair rugby players and the distances covered during a game especially at higher velocities, providing evidence to support the use of kinematical variables in the sport specific classification system.

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